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(71)出願人　596115609
柯　建　信
台湾台北市士林区中社路２段７号
(72)発明者　柯　建　信
台湾台北市士林区中社路２段７号
(74)代理人　100070150
弁理士　伊東　忠彦　（外１名）

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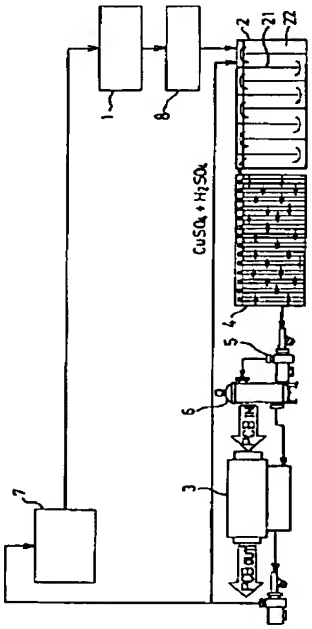
(54)【発明の名称】　非溶解性陽極による電気メッキ法及びその装置

(57)【要約】
【課題】　陽極を補充する必要がなく電気メッキ液の濃度を均一に保持でき、陽極形状が陰極のメッキ材の外観形状に応じて任意に改変でき、電流分布の不均一を防止し均一な電気メッキ効果を得られる非溶解性陽極による電気メッキ法及びその装置を提供する。
【解決手段】　本発明の非溶解性陽極による電気メッキ法は、酸化銅或いは炭酸銅の少なくとも一種類を含んだ銅化合物を供給し、硫酸により解離して銅イオン電解液を形成し、続いて該銅イオン電解液を非溶解性陽極を具えたメッキタンクに送って電気メッキを行ない、これにより電解液が陽極を溶解する必要がなくなり、均一な電気メッキ効果を得られて、陽極の交換作業を節減できる。また、上記方法に使われる装置は、酸化銅或いは炭酸銅の少なくとも一種類を含む銅化合物を供給する原料供給タンクａと、複数の解離室を具えて供給される銅化合物を硫酸により解離する解離タンクと、解離タンク内で造られた電解液を導入して電気メッキを行なう電気メッキタンクとを具えて構成される。



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【特許請求の範囲】

【請求項１】　酸化銅或いは炭酸銅の少なくとも一種類を含んだ銅化合物を供給する添加ステップと、
上記添加ステップで添加した銅化合物を硫酸により解離して銅イオン電解液を形成する解離ステップと、
上記解離ステップで得られた銅イオン電解液をメッキタンクに送り電気メッキを行なう電気メッキステップと、
を含んでなる非溶解性陽極による電気メッキ法。

【請求項２】　上記添加ステップが更に流量制御ステップを含み、銅化合物の供給量を制御する請求項１に記載の非溶解性陽極による電気メッキ法。

【請求項３】　上記解離ステップの後に純化ステップを挿し込み、該解離ステップで得られた銅イオン電解液中に含まれる非銅金属イオンを電解沈殿させ除去する請求項１に記載の非溶解性陽極による電気メッキ法。

【請求項４】　上記純化ステップが弱電解法を採用して、非銅金属イオンを除去する請求項３に記載の非溶解性陽極による電気メッキ法。

【請求項５】　上記解離ステップで使われる硫酸を、電気メッキステップで残余した硫酸液体を回流させ供給する請求項１に記載の非溶解性陽極による電気メッキ法。

【請求項６】　純化ステップの弱電解法で使われる電極をチタン金属で形成してなる請求項４に記載の非溶解性陽極による電気メッキ法。

【請求項７】　上記電気メッキステップが更に、
ａ）メッキ材の表面形状に応じて、それとマッチする非溶解性陽極部材を製作し、
ｂ）メッキ材を陰極に固定して、上記製作された非溶解性陽極部材を該メッキ材と適当な間隔距離に配置し、
ｃ）上記陰極及び陽極に電気を導通して電気メッキを行なうステップを含んでなる請求項１に記載の非溶解性陽極による電気メッキ法。

【請求項８】　上記非溶解性陽極部材をチタン被覆酸化イリジウム材で形成してなる請求項７に記載の非溶解性陽極による電気メッキ法。

【請求項９】　上記非溶解性陽極部材を多孔性平板状に形成してなる請求項８に記載の非溶解性陽極による電気メッキ法。

【請求項１０】　上記非溶解性陽極部材とメッキ材との間隔距離が２～３cmである請求項７に記載の非溶解性陽極による電気メッキ法。

【請求項１１】　酸化銅或いは炭酸銅の少なくとも一種類を含む銅化合物を貯蔵および供給する原料供給タンクと、
上記原料供給タンクから送られる銅化合物の格納空間を具え、該格納空間を仕切板により複数の互いに連通する解離室に仕切り、且つ硫酸の含んだ電気メッキ廃液を供給して、該原料供給タンクから供給される銅化合物を解離する解離タンクと、
電解液入口と電気メッキ廃液出口を具え、該電解液入口より上記解離タンクで解離して得られた銅イオン電解液を導入して電気メッキを行ない、該電気メッキ廃液口より電気メッキ残余廃液を排出する電気メッキタンクと、
を含んでなる非溶解性陽極による電気メッキ装置。

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【請求項１２】　上記解離タンクの出口端部に純化タンクを設け、該解離タンクから送られる電解液を受け取らせ、該純化タンク内に一個以上の電極を取付けて、弱電解を行なわせ該純化タンク内部の電解液を純化する請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項１３】　上記純化タンクで採用した電極をチタン金属で形成してなる請求項１２に記載の非溶解性陽極による電気メッキ装置。

【請求項１４】　上記電気メッキタンクの電解液入口の手前に輸送部材を設け、電解液の電気メッキタンクへの輸送を強化する請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項１５】　上記輸送部材を加圧ポンプで形成してなる請求項１４に記載の非溶解性陽極による電気メッキ装置。

【請求項１６】　上記電気メッキタンクの電解液入口と上記純化タンクとの間に濾過部材を設け、流動経過する電解液から更に雑質を濾過除去する請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項１７】　上記濾過部材を孔の細かい濾過材或いは活性炭により形成してなる請求項１６に記載の非溶解性陽極による電気メッキ装置。

【請求項１８】　上記電気メッキタンクの電気メッキ廃液出口に回流管の一端を連結して、該回流管の他端を上記解離タンクに連接し、該電気メッキタンク内の電気メッキ廃液を該解離タンクに回流させるようにしてなる請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項１９】　上記電気メッキ廃液出口にセンサーを取付けて、該電気メッキ廃液出口から流出する電気メッキ廃液内の銅イオン濃度を探知させ、且つ上記原料供給タンク出口に該センサーと連線する供給量制御部材を設けて、該センサーの探知数値に応じて該原料供給タンクの送出供給量を制御するようにしてなる請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項２０】　上記電気メッキタンクが、
メッキ材を掛け吊る陰極と、
その外部形状が該メッキ材の表面形状とマッチする金属材製の非溶解性陽極部材と、
を具えてなる請求項１１に記載の非溶解性陽極による電気メッキ装置。

【請求項２１】　上記非溶解性陽極部材をチタン被覆酸化イリジウムで形成してなる請求項２０に記載の非溶解性陽極による電気メッキ装置。

【請求項２２】　上記非溶解性陽極部材を多孔性平板状に形成してなる請求項２０に記載の非溶解性陽極による電気メッキ装置。

【請求項２３】　上記非溶解性陽極部材と上記陰極との間隔距離が２～３cmである請求項２０に記載の非溶解性陽極による電気メッキ装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は非溶解性陽極による電気メッキ法及びその装置に関し、特に陽極を補充する必要がなく電気メッキ液濃度を均一に保持し、陽極形状が陰極のメッキ材形状に応じて任意に改変でき、電流密度の不均一性を低減して均一な電気メッキ効果を得られる非溶解性陽極による電気メッキ法及びその装置に関する。

【０００２】

【従来の技術】従来から、高純度な銅皮膜を必要とする例えば、プリント回路（ＰＣＢ）や集積回路板（ＩＣ）等の電気メッキ法は、メッキタンクに一個以上の非溶解性チタン金属網篭を設け、該チタン金属網篭内に金属銅（ペレット）を装入し陽極とし、同時に剥き出しメッキ材を陰極として裸のまま直接該メッキタンク内に載置し、直流電気を導通して酸化・還元を経て電気メッキを進める。

【０００３】然しながら、この種の従来の電気メッキ法は、下記のように色々な欠点がある。即ち、

ａ）陽極の体積が大きい

電気メッキで必要な銅イオンは立体形状のチタン金属網篭内に装入した銅金属から得られるため、大量生産に応じて、必ず該チタン金属網篭にかなりの量の金属銅を入れなければならない。そのため、陽極の体積が頗る大きくなり、陰極との距離を縮めるのが難しく、使用電流の浪費を形成する。

【０００４】ｂ）陽極の補充が困難

上記従来のメッキタンク内におけるチタン金属網篭に装入される金属銅は、導電時間の経過と共に徐々に消耗されるため、ときどき補充しなければならないが、一般の電気メッキはみな連続操業方式を採用して、陽極となるチタン金属網篭がメッキタンク内に固定されていることから、金属銅を補充する場合は必ず運転を停止し、陽極装置を取り外して補充しなければならず、著しく生産効率が影響され、徒らに作業コストが高くなる。

【０００５】ｃ）電流密度が不均一

図３に示す如く、一般的な陰極メッキ材の表面は必ずしも完全に平滑ではなく、凹凸不規則な場合もあり、高精密を要求される電気メッキでは、もしも陽極外形を陰極のメッキ材外形と等しく形成しないと、陰、陽両極が等電位に互いに対応することができず、電流が局部的に比較的距離近いメッキ材の図示のＡ部位に集中し、電流密度の分布が不均一な現象を生じ、電気メッキの不均一という悪い結果が出る。このように、メッキ装置内の陽極形状を陰極のメッキ材形状に追従して同期に調整することができず、高精密電気メッキの要求に合わない。



【０００６】ｄ）陽極粒子が脱落

電気導通の時間経過に伴って、該金属銅が表面から酸化解離されて徐々に体積が縮小し、該金属銅の体積が解離縮小してチタン金属網篭の網目よりも小さくなると、該チタン金属網篭の網目から脱落してメッキタンクに沈殿し、或いはメッキ材に付着して、メッキ材の表面がざらざらとなり、品質に悪い影響をもたらす。

【０００７】上記従来の電気メッキ法における色々な欠点に鑑み、遂に非溶解性陽極が採用されるようになり、この際、メッキタンク内に硫酸銅結晶（$CuSO_4 \cdot 5H_2O$）を供給して、メッキ浴中のメッキから消耗される銅イオンを補充するようにしている。そして、直流電気を陰、陽極へ流すと、次の反応が生ずる。

❶硫酸銅解離反応

$CuSO_4 \cdot 5H_2O \rightarrow Cu^{+2} + SO_4^{-2} + 5H_2O$

❷陽極反応

$H_2O \rightarrow 2H^+ + 1/2O_2 + 2e^-$

❸陰極反応

$Cu^{+2} + 2e^- \rightarrow Cu$

これらの反応ステップから分かるように、この種類の電気メッキ法は、１モルの硫酸銅結晶を添加するごとに、メッキタンク内で余分な１モルの硫酸イオン（$SO_4^{-2}$）及び４モルの水分子（$H_2O$）が生ずる。その結果、電解液が著しく稀釈され、電解液中の硫酸イオンが大幅に増加し、電解液濃度のアンバランス状態が厳重になり、電気メッキの安定性に影響をもたらす。

【０００８】

【発明が解決しようとする課題】上記従来の電気メッキ法における色々な問題点に鑑み、本発明の第１の目的は、陽極を補充する必要がなく電気メッキ液濃度を均一に保持でき、陽極形状が陰極のメッキ材外形に応じて任意に改変でき、電流密度の不均一性を低減して均一な電気メッキ効果を得られる非溶解性陽極による電気メッキ法を提供することである。

【０００９】また、本発明の第２の目的は、上記本発明が提供する非溶解性陽極による電気メッキ法に使用される、上記電気メッキ法の効果を達成できると共に電気メッキ廃液のリサイクル効果を具えた装置を提供することにある。

【００１０】

【課題を解決するための手段】上記第１の目的を達成するため、本発明の非溶解性陽極による電気メッキ方法は、酸化銅或いは炭酸銅の少なくとも一種類を含んだ銅化合物を供給する添加ステップと、上記添加ステップで添加した銅化合物を硫酸により解離して銅イオン電解液を形成する解離ステップと、上記解離ステップで得られた銅イオン電解液をメッキタンクに送り電気メッキを行なう電気メッキステップと、を含んで構成される。

【００１１】また、上記第２の目的を達成するため、本発明の非溶解性陽極による電気メッキ装置は、酸化銅或

いは炭酸銅の少なくとも一種類を含む銅化合物を貯蔵および供給する原料供給タンクと、上記原料供給タンクから送られる銅化合物の格納空間を具え、該格納空間を仕切板により複数の互いに連通する解離室に仕切り、且つ硫酸を含んだ電気メッキ廃液を供給され、該原料供給タンクから供給される銅化合物を解離する解離タンクと、電解液入口と電気メッキ廃液出口を具え、該電解液入口より上記解離タンクで解離し得られた銅イオン電解液を導入して電気メッキを行ない、該電気メッキ廃液口より電気メッキ残余廃液を排出する電気メッキタンクとを含んで構成される。

【００１２】そして、上記方法及びその装置について、それぞれの細部にわたって色々と工夫を凝らして、好適なステップ或いは部材・機構を付け加え、より作用、効果を向上させるように図ると、一層好ましい。上記のように構成された本発明は、陽極に大量の銅金属ブロックを補充する必要がなく、同時に陽極もプレート状またはシート状の非溶解性電極を採用することができ、陰極のメッキ材形状に合わせて適当なマッチした形状に形成することができ、また陽極と陰極との間隔距離を自由に調整することができる。

【００１３】その結果、従来技術における電流の局部集中現象が生じなくなり、電流密度が均一に行き渡って、均一な電気メッキを達成することができると共に、陰極と陽極との間隔距離が容易に制御できることから、大幅に電気メッキの精密度を向上させることができる。即ち、本発明が提供する陽極は、電気メッキ過程で電極自体が溶解せず、したがってメッキ材を直接陰極に掛け吊って、同時に陽極を該メッキ材と同じ外観形状に形成し、電気メッキタンク内の電流分布を均一にし、電流が局部集中してメッキ材の表面にメッキの不均一な現象が生ずるのを防止することができる。

【００１４】

【発明の実施の形態】以下、本発明を実施の形態例に基づいて具体的に説明するが、本発明はこの例だけに限定されない。先ず、図１に示す如く、本発明の非溶解性陽極による電気メッキ法の主な作業順序はほぼ次の３つの大きなステップに分けられる。

１）添加ステップ

原料供給タンク１に結晶水を含まない銅化合物を装入し、予備貯蔵原料とする。いわゆる「無水銅化合物」とは、水分子結晶を含まない銅化合物を指し、例えば、酸化銅、炭酸銅などが挙げられる。

２）解離ステップ

上記原料供給タンク１に貯蔵された銅化合物を解離タンク２に送り、該解離タンク２内に収容された硫酸液により解離を行ない、硫酸銅（$CuSO_4$）溶液を生じさせる。その解離反応は、もし添加したのが酸化銅である時、下記の通りである。

【００１５】



$CuO_{(s)} + H_2SO_4 \rightarrow CuSO_4 + H_2O$

もしも添加したのが炭酸銅である時は、下記の通りである。

$CuCO_{3(s)} + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$

３）電気メッキステップ

上記解離タンク２内で形成した硫酸銅溶液を電解液として電気メッキタンク３内に送り込み、該電気メッキタンク３内で銅メッキを行なう。

【００１６】上記本発明が提供する３つの大きなステップにより、陽極中に大量の銅金属ブロックを入れる必要がなくなり、同時に陽極も非溶解性電極を採用することができ、且つ陰極におけるメッキ材形状に合わせて適当にマッチ（例えば同じ外表形状に形成する）させることもでき、また陽極と陰極との間隔距離を自由に調整することができる。そして、上記改善した結果により、電流の局部集中現象が生じなくなると共に、電流分布が均一に行き渡って、均一な電気メッキを達成することができ、更に陰極と陽極との間隔距離が容易に制御できることから、大幅に電気メッキの精密度を向上させることができる。

【００１７】また、本発明が提供する電気メッキ法のなかで、電気メッキタンク３内の電解液をより純化させるため、解離ステップを行なった後に、更に純化ステップを施して、得られた電解液中に含まれている非銅イオン（例えば、$Fe^{+3}$，$Zn^{+2}$など）雑質を除去するようにしてもよい。上記純化ステップは、弱電解純化タンク４に多数のチタン金属電極によって組立てられた電解沈殿室を設置し、弱電流を通して電解液中に夾雑されている雑質を沈殿させて除去することができる。該弱電解純化タンク４は上記解離タンク２の下流側に設けてよく、該解離タンク２で得られた硫酸銅電解液を受け入れて純化する。

【００１８】他にも、上記解離タンク２は、添加された銅化合物を充分に解離させるため、その内部を仕切板２１により複数の上下連通交叉する格納空間２２に仕切って、上記原料供給タンク１内に貯蔵されている銅化合物を解離タンク２の一端から導入し、更に各格納空間２２へと順に経て、充分に解離してから他端より流出させて次のステップに輸送する。

【００１９】一般に電気メッキタンク３内の硫酸銅電解液は、電解メッキを経た後、陰極に剰余した硫酸根イオン（$SO_4^{-2}$）と陽極で生じた$H^+$が硫酸溶液の電気メッキ廃液を形成する。また、電気メッキ過程で電気メッキタンク３内の硫酸銅溶液濃度は徐々に薄くなり、遂に使用できない硫酸銅廃液となる。そして、この低濃度硫酸銅溶液と硫酸溶液を含んだ電気メッキ廃液を充分に利用するため、該電気メッキタンク３にそれぞれ電解液入口及び電気メッキ廃液出口を設けて、個別に電解液を受入れ及び電気メッキ廃液を排出し、更に該電気メッキ廃

液を上記解離タンク２に回流させてリサイクル処理を行なわせ、全体システムを一つの循環管路に形成する。本発明が提供する方法及び装置を利用すると、任意に電気メッキ廃液が放出され環境汚染が生ずるのを防止することができる。

【００２０】本発明のシステムで輸送される硫酸銅電解液がよりスムーズに電気メッキタンク３内に流動移送されるため、上記弱電解純化タンク４下流に輸送部材５を設けてもよく、該輸送部材５を加圧ポンプで形成し、該弱電解純化タンク４内の電解液を加圧輸送し管路の流通を確保することができる。また、電気メッキタンク３内の送り込まれる電解液をより純化させるため、該電気メッキタンク３の電解液入口前に濾過部材６を装設してもよく、該濾過部材６を孔の細かい濾過材或いは活性炭で形成して、これにより、電解液内に夾雑されている雑質を更に一歩進んで除去することができる。

【００２１】そして、該解離タンク２内で造られた硫酸銅電解液を一定の水準以上に保持できるようにするため、同時に該原料供給タンク１から添加される銅化合物の量が多過ぎて浪費になるのを防止するため、該電気メッキタンク３の電気メッキ廃液の回流管路にセンサー７を外接して、該原料供給タンク１の出口端部に供給量制御部材８を装設し、且つ該センサー７と該供給量制御部材８とを連線して、該センサー７を濃度測定分析機で形成する。これにより、該センサー７がそれぞれ電気メッキタンク３内の回流する電気メッキ廃液に夾雑混合される硫酸銅及び硫酸廃液の濃度を探知して、進んで該供給量制御部材８により該原料供給タンク１から供給される含銅混合物の速度を制御する。該供給量制御部材８については特に制限はなく、流量を調節制御できればよい。例えば一般常用の従来の流量制御バルブを採用することができる。

【００２２】また、図２に示すように、上記電気メッキタンク３内で使用する陽極電極を非溶解性陽極で形成する。その材質については特に制限はなく、単に良好な導電性を具えた非電気溶解性のものであればよい。例えば、チタン被覆の酸化イリジウムで形成した材質のものを採用する。このように、本発明が提供する陽極は、電気メッキ過程で電極自体が溶解せず、したがってメッキ材を直接陰極に掛け吊って、同時に陽極を該メッキ材と同じ外観形状に形成し、これにより電気メッキタンク３内の電流分布を均一にして、電流が局部集中してメッキ材の表面にメッキの不均一な現象が生ずるのを防止することができる。

【００２３】更に、電気メッキタンク３内の電流の流通がスムーズであるようにするため、該陽極を多孔性平板状に造ってもよい。また、電気メッキの精密度を確保するため、陽極と陰極との間隔距離を努めて接近させ、２～３cm範囲左右に保持すると最も好ましい。

【００２４】

【発明の効果】上記のように構成された本発明の「非溶解性陽極による電気メッキ法及び装置」は、電気メッキタンク内で生ずる電気メッキ廃液を充分にリサイクルできると共に、硫酸銅電解液の濃度をいつも必要程度に保持することができ、且つ陽極形状をメッキ材の形状に応じて自由に変化させ得るため、電流が局部的に集中する不良現象が発生するのを防止できる。更に、本発明で使っている銅化合物は水分子を含んでいないため、電気メッキタンク内の電解液に対して稀釈作用が生じず、エネルギー消耗を節減でき、経済収益を向上させることができる。言い換えると、陰極のメッキ材と外観形状がマッチする非溶解性陽極を採用し、陰極と陽極との間隔距離を大幅に短縮できるため、電気メッキの精密度を確保でき、高精密電子素子に大きく貢献することができる。

【図面の簡単な説明】

【図１】本発明における比較的好ましい実施例の装置レイアウト表示図である。

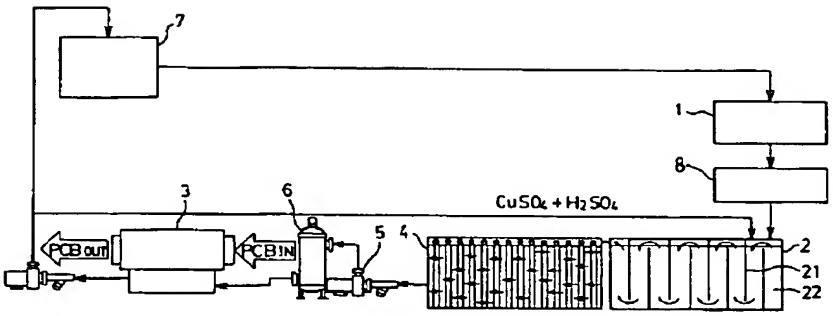
【図２】本発明における非溶解性陽極とメッキ材との配置図である。

【図３】従来の溶解性陽極とメッキ材との配置図である。

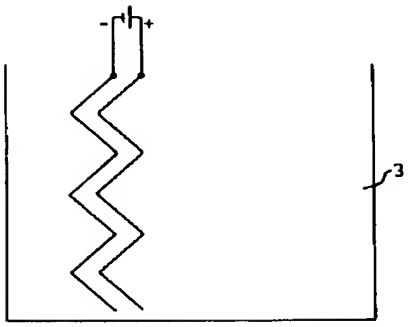
【符号の説明】

１　原料供給タンク
２　解離タンク
３　電気メッキタンク
４　弱電解純化タンク
５　輸送部材
６　濾過部材
７　センサー
８　供給量制御部材
２１　仕切板
２２　格納空間

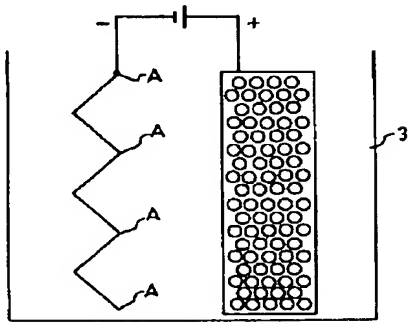
【図１】




【図２】




【図３】

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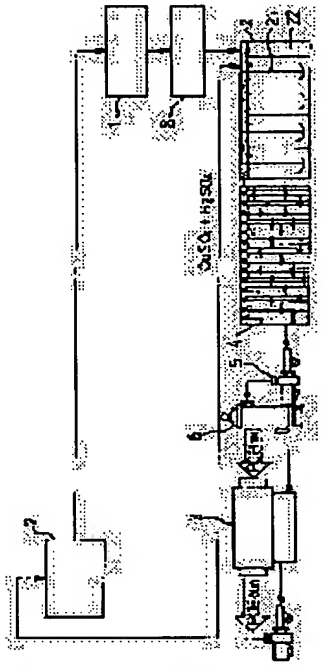
(71)Applicant : KA KENSHIN
(72)Inventor : KA KENSHIN

## (54) ELECTROPLATING USING INSOLUBLE ANODE AND DEVICE THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electroplating method using an insoluble anode and a device therefor by which the concn. of an electroplating soln. is kept constant without need to replenish an anode, the shape of the anode can be optionally changed in accordance with the appearance and shape of a plating material of a cathode, nonuniformity of current distribution is prevented, and a uniform electroplating effect is obtained.
SOLUTION: A copper compd. contg. at least one of copper oxide and copper carbonate is supplied and dissolved by sulfuric acid to form a copper-ion electrolyte, and the resultant copper ion electrolyte is sent to a plating tank provided with an insoluble anode to conduct electroplating. Consequently, the anode need not be dissolved in the electrolyte, a uniform electroplating effect is obtained, and the anode exchanging work is reduced. Further, the device used in the method is furnished with a raw material feed tank 1 for supplying a copper compd. contg. at least one of copper oxide and copper carbonate, a dissociation tank 2 provided with plural dissociation chambers and dissociating the supplied copper compd. by sulfuric acid, and an electroplating tank 3 receiving the electrolyte prepared in the dissociation tank 2 and conducting electroplating.



LEGAL STATUS

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CLAIMS

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[Claim(s)]
[Claim 1] The electroplating method by the undissolved anode plate which comes to contain the addition step which supplies a copper compound including at least one kind of copper oxide or copper carbonate, the dissociation step which dissociates the copper compound added at the above-mentioned addition step with a sulfuric acid, and forms the copper ion electrolytic solution, and the electroplating step which performs delivery electroplating for the copper ion electrolytic solution obtained at the above-mentioned dissociation step to a plating bath.
[Claim 2] The electroplating method by the undissolved anode plate according to claim 1 where the above-mentioned addition step controls the amount of supply of a copper compound including a control-of-flow step further.
[Claim 3] The electroplating method by the undissolved anode plate according to claim 1 which puts a purification step after the above-mentioned dissociation step, is made to carry out electrolysis precipitate of the non-copper metal ion contained in the copper ion electrolytic solution obtained at this dissociation step, and is removed.
[Claim 4] The electroplating method by the undissolved anode plate according to claim 3 which the above-mentioned purification step adopts a weak-electric-current solution method, and removes a non-copper metal ion.
[Claim 5] The electroplating method by the undissolved anode plate according to claim 1 which is made to carry out the time style of the sulfuric-acid liquid which carried out the remainder of the sulfuric acid used at the above-mentioned dissociation step at the electroplating step, and supplies it.
[Claim 6] The electroplating method by the undissolved anode plate according to claim 4 which comes to form the electrode used by the weak-electric-current solution method of a purification step with a titanium metal.
[Claim 7] The electroplating method by the undissolved anode plate according to claim 1 which the above-mentioned electroplating step manufactures further the undissolved anode plate member which matches it according to the shape of surface type of a plating material, fixes b plating material to cathode, and comes to contain the step which arranges the undissolved anode plate member by which manufacture was carried out [ above-mentioned ] in this plating material and a suitable spacing distance, flows through the electrical and electric equipment in the c above-mentioned cathode and an anode plate, and performs electroplating.
[Claim 8] The electroplating method by the undissolved anode plate according to claim 7 which comes to form the above-mentioned undissolved anode plate member by titanium covering oxidization iridium material.
[Claim 9] The electroplating method by the undissolved anode plate according to claim 8 which comes to form the above-mentioned undissolved anode plate member in porous plate-like one.
[Claim 10] The electroplating method by the undissolved anode plate according to claim 7 whose spacing distance of the above-mentioned undissolved anode plate member and plating material is 2-3cm.
[Claim 11] The feeding tank which stores and supplies a copper compound including at least one kind of copper oxide or copper carbonate, The electroplating waste fluid which was equipped with the storing space of the copper compound sent from the above-mentioned feeding tank, and divided this storing space into the dissociation room which is mutually [ plurality ] open for free passage with a dashboard, and the sulfuric acid contained is supplied. The dissociation tank which dissociates the copper compound supplied from this feeding tank, The electric plating bath which is equipped with an electrolytic-solution inlet port and an electroplating waste fluid outlet, introduces the copper ion electrolytic solution dissociated and obtained by the above-mentioned dissociation tank from this electrolytic-solution inlet port, performs electroplating, and discharges electroplating residual waste fluid from this electroplating waste fluid opening, Electroplating equipment by the undissolved anode plate which becomes by ******.
[Claim 12] Electroplating equipment by the undissolved anode plate according to claim 11 which forms a purification tank in the outlet edge of the above-mentioned dissociation tank, is made to receive the electrolytic solution sent from this dissociation tank, attaches the electrode more than a piece in this purification tank, is made to perform a weak-electric-current solution, and purifies the electrolytic solution inside this purification tank.
[Claim 13] Electroplating equipment by the undissolved anode plate according to claim 12 which comes to form the electrode adopted by the above-mentioned purification tank with a titanium metal.
[Claim 14] Electroplating equipment by the undissolved anode plate according to claim 11 which prepares a transportation member before the electrolytic-solution inlet port of the above-mentioned electric plating bath, and strengthens transportation to the electric plating bath of the electrolytic solution.
[Claim 15] Electroplating equipment by the undissolved anode plate according to claim 14 which comes to form the above-mentioned transportation member by the booster pump.
[Claim 16] Electroplating equipment by the undissolved anode plate according to claim 11 which prepares a filtration member between the electrolytic-solution inlet port of the above-mentioned electric plating bath, and the above-mentioned purification tank, and carries out filtration removal of the **** further from the electrolytic solution which carries out flow progress.
[Claim 17] Electroplating equipment by the undissolved anode plate according to claim 16 which comes to form the above-mentioned filtration member with the fine filter media or the activated carbon of a hole.
[Claim 18] Electroplating equipment by the undissolved anode plate according to claim 11 which connects the end of the time flow tube with the electroplating waste fluid outlet of the above-mentioned electric plating bath, connects [ outlet ] the other end of this time flow tube at the above-mentioned dissociation tank, and makes use it as this dissociation tank in the style of a time and comes to

make the electroplating waste fluid in this electric plating bath.
[Claim 19] Electroplating equipment by the undissolved anode plate according to claim 11 as attaches a sensor in the above-mentioned electroplating waste fluid outlet, and is made to detect the copper ion concentration in the electroplating waste fluid which flows out of this electroplating waste fluid outlet, and prepares the amount-of-supply control-section material which **** with this sensor to the above-mentioned feeding tank outlet and comes to control the sending-out amount of supply of this feeding tank according to the detection numeric value of this sensor.
[Claim 20] Electroplating equipment by the undissolved anode plate according to claim 11 which comes to have the cathode from which the above-mentioned electric plating bath hangs and hangs plating material, and the undissolved anode plate member made from metal material by which the external configuration matches the shape of surface type of this plating material.
[Claim 21] Electroplating equipment by the undissolved anode plate according to claim 20 which comes to form the above-mentioned undissolved anode plate member with titanium covering oxidization iridium.
[Claim 22] Electroplating equipment by the undissolved anode plate according to claim 20 which comes to form the above-mentioned undissolved anode plate member in porous plate-like one.
[Claim 23] Electroplating equipment by the undissolved anode plate according to claim 20 whose spacing distance of the above-mentioned undissolved anode plate member and the above-mentioned cathode is 2-3cm.

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[Translation done.]

* NOTICES *



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] About the electroplating method by the undissolved anode plate, and its equipment, this invention does not need to fill up especially an anode plate and holds electroplating liquid concentration to homogeneity, and an anode plate configuration can change to arbitration according to the plating material configuration of cathode, and is related with the electroplating method by the undissolved anode plate which reduces the heterogeneity of current density and can acquire the uniform electroplating effectiveness, and its equipment.
[0002]
[Description of the Prior Art] Electroplating methods, such as a printed circuit (PCB), an integrated-circuit plate (IC), etc. which needs a high grade copper coat from the former, form the undissolved titanium metal net basket more than a piece in a plating bath, insert in metal copper (pellet) in this titanium metal net basket, make it an anode plate, show in coincidence, lay in this plating bath directly by using plating material as cathode with nakedness, flow through the direct-current electrical and electric equipment, and advance electroplating through oxidation and reduction.
[0003] However, this kind of conventional electroplating method has faults various as follows. That is, since a copper ion required of electroplating with the large volume of a anode plate is obtained from the copper metal inserted in in the titanium metal net basket of a solid configuration, it must put most quantity of metal copper into this titanium metal net basket according to mass production method. Therefore, the volume of an anode plate becomes very large, it is difficult to contract distance with cathode, and it forms waste of the working current.
[0004] b) The metal copper with which the supplement of an anode plate is inserted in the titanium metal net basket in the plating bath of the difficult above-mentioned former Although it must sometimes supply since it is gradually exhausted with the electric conduction passage of time, all general electroplating adopts a continuation operation method. Since the titanium metal net basket used as an anode plate is being fixed in the plating bath, when filling up metal copper, operation must be suspended, anode plate equipment must be removed and filled up, productive efficiency is influenced remarkably, and activity cost becomes high at ** and others.
[0005] c) current density shows ununiformity drawing 3 — as — the front face of general cathode plating material — not necessarily — perfect — not smooth — irregularity — in electroplating of which it may be irregular and a high precision is required if an anode plate appearance is not formed equally to the plating material appearance of cathode — shade and positive two poles — equipotential — mutual — it cannot respond — a current — local — comparatively — distance — it concentrates on the A-site of illustration of near plating material, distribution of current density produces an uneven phenomenon, and the bad result of the ununiformity of electroplating comes out. Thus, the plating material configuration of cathode cannot be followed, the anode plate configuration in a gilding machine cannot be adjusted to a synchronization, and the demand of high precision electroplating is not suited.
[0006] d) Oxidization dissociation of this metal copper is carried out for an anode plate particle from a front face with time amount progress of an omission electrical-and-electric-equipment flow, and the volume contracts gradually, if the volume of this metal copper carries out dissociation contraction and becomes smaller than the mesh of a titanium metal net basket, it will drop out of the mesh of this titanium metal net basket, and it precipitates to a plating bath, or adhere to plating material, and the front face of plating material becomes coarsely, and bring bad effect to quality.
[0007] An undissolved anode plate comes to be adopted at last, and he supplies a copper-sulfate crystal (CuSO4 and 5H2O) in a plating bath in this case, and is trying to fill up the copper ion exhausted from plating under plating bath in view of various faults in the conventional describing [ above ] electroplating method. And if the direct-current electrical and electric equipment is passed to shade and an anode plate, the next reaction will arise.
** copper-sulfate dissociative-reaction CuSO4 and 5H2 O->Cu+2+SO4-2+5H2 O** anodic reaction H2 O->2H++1/2O2+2e-** cathode reaction Cu+2+2e-->Cu — so that these reaction steps may show Whenever this kind of electroplating method adds an one-mol copper-sulfate crystal, one mol excessive sulfate ion (SO 4-2) and a four-mol water molecule (H2 O) produce it within a plating bath. Consequently, the electrolytic solution is diluted remarkably, the sulfate ion in the electrolytic solution increases sharply, the imbalance condition of electrolytic-solution concentration becomes severe, and effect is brought to the stability of electroplating.
[0008]
[Problem(s) to be Solved by the Invention] It is offering the electroplating method by the undissolved anode plate which the 1st purpose of this invention does not need to fill up an anode plate in view of various troubles in the conventional describing [ above ] electroplating method, and can hold electroplating liquid concentration to homogeneity, an anode plate configuration's can change to arbitration according to the plating material appearance of cathode, reduces the heterogeneity of current density, and can acquire the uniform electroplating effectiveness.
[0009] Moreover, the 2nd purpose of this invention is to offer equipment equipped with the recycle effectiveness of electroplating waste fluid while being able to attain the effectiveness of the describing [ above ] electroplating method used for the electroplating method by the undissolved anode plate which above-mentioned this invention offers.
[0010]
[Means for Solving the Problem] In order to attain the 1st purpose of the above, the electroplating approach by the undissolved anode

plate of this invention is constituted including the electroplating step which performs delivery electroplating to a plating bath in the copper-ion electrolytic solution obtained at the addition step which supplies a copper compound including at least one kind of copper oxide or copper carbonate, the dissociation step which dissociates the copper compound added at the above-mentioned addition step with a sulfuric acid, and forms the copper ion electrolytic solution, and the above-mentioned dissociation step.

[0011] In order to attain the 2nd purpose of the above, moreover, the electroplating equipment by the undissolved anode plate of this invention The feeding tank which stores and supplies a copper compound including at least one kind of copper oxide or copper carbonate, Have the storing space of the copper compound sent from the above-mentioned feeding tank, and this storing space is divided into the dissociation room which is mutually [ plurality ] open for free passage with a dashboard. And the dissociation tank which dissociates the copper compound which the electroplating waste fluid containing a sulfuric acid is supplied, and is supplied from this feeding tank, It has an electrolytic-solution inlet port and an electroplating waste fluid outlet, and the copper ion electrolytic solution which might be dissociated by the above-mentioned dissociation tank is introduced, electroplating is performed, and it consists of these electrolytic-solution inlet ports including the electric plating bath which discharges electroplating residual waste fluid from this electroplating waste fluid opening.

[0012] And when it plans so that creativity may be variously put over each details, a suitable step, or a member and a device may be added and an operation and effectiveness may be raised more about the above-mentioned approach and its equipment, it is much more desirable. It is not necessary to supplement an anode plate with a lot of copper metal block, an anode plate can also adopt the undissolved electrode of the shape of the shape of a plate, and a sheet as coincidence, and this invention constituted as mentioned above can form it in the suitable configuration which matched according to the plating material configuration of cathode, and can adjust the spacing distance of an anode plate and cathode freely.

[0013] Consequently, while it becomes impossible for the local concentration phenomenon of the current in the conventional technique to arise, and current density can spread round homogeneity and being able to attain uniform electroplating, the precision of electroplating can be sharply raised from the ability of the spacing distance of cathode and an anode plate to control easily. That is, it can prevent that the electrode itself does not dissolve in an electroplating process, therefore plating material is hung on direct heated cathode, hang it, form an anode plate in coincidence at the same appearance configuration as this plating material, make current distribution in an electric plating bath into homogeneity, a current carries out local concentration, and the uneven phenomenon of plating produces the anode plate which this invention offers on the front face of plating material.

[0014]

[Embodiment of the Invention] Hereafter, although this invention is concretely explained based on the example of a gestalt of operation, this invention is not limited only to this example. First, as shown in drawing 1 , the main operation sequencing of the electroplating method by the undissolved anode plate of this invention is mostly divided into the following three big steps.

1) Insert in the addition step feeding tank 1 the copper compound which does not contain water of crystallization, and consider as a preliminary storage raw material. The so-called "anhydrous copper compound" points out the copper compound which does not contain water molecular crystal, for example, copper oxide, copper carbonate, etc. are mentioned.

2) Dissociate with the sulfuric-acid liquid held by the dissociation tank 2 in delivery and this dissociation tank 2 in the copper compound stored in the dissociation step above-mentioned feeding tank 1, and produce a copper-sulfate (CuSO4) solution. The dissociative reaction is as being the following, when what was added is copper oxide.

[0015]

CuO (s) +H2 SO4 -> CuSO4+H2 O — it is as follows when what was added is copper carbonate.

CuCO3 (s) +H2 SO4 -> It sends in in the electric plating bath 3 by using as the electrolytic solution the copper-sulfate solution formed within the CuSO4+H2 O+CO23 electroplating step above-mentioned dissociation tank 2, and coppering is performed within this electric plating bath 3.

[0016] By three big steps which above-mentioned this invention offers, it becomes unnecessary to put in a lot of copper metal block all over an anode plate, and an anode plate can also adopt an undissolved electrode as coincidence, it can also be made to be able to match suitably according to the plating material configuration in cathode (for example, it forms in the same outside table configuration), and the spacing distance of an anode plate and cathode can be adjusted freely. And the precision of electroplating can be sharply raised from the ability of the spacing distance of cathode and an anode plate for current distribution to spread round homogeneity, and for uniform electroplating to be attained, and control by the result which carried out [ above-mentioned ] the improvement easily further, while the local concentration phenomenon of a current stops arising.

[0017] Moreover, after performing a dissociation step, a purification step is given further and you may make it remove non-copper ion **** (for example, Fe+3, Zn+2, etc.) contained in the obtained electrolytic solution in the electroplating method which this invention offers, in order to make the electrolytic solution in the electric plating bath 3 purify more. The above-mentioned purification step can install the electrolysis sedimentation compartment assembled by the weak-electric-current solution purification tank 4 with many titanium metal electrodes, can settle **** with which it is contaminated in the electrolytic solution through the weak-electric-current style, and can be removed. This weak-electric-current solution purification tank 4 may be formed in the downstream of the above-mentioned dissociation tank 2, receives the copper-sulfate electrolytic solution obtained by this dissociation tank 2, and purifies.

[0018] In order to make the copper compound with which the above-mentioned dissociation tank 2 was otherwise added fully dissociate, after a batch introduces the copper compound stored in the above-mentioned feeding tank 1 from the end of the dissociation tank 2, passes through it in order to each storing space 22 further and fully dissociating it, make it flow into the storing space 22 where plurality carries out vertical free passage decussation of the interior with a dashboard 21 from the other end, and it conveys to it at the following step.

[0019] Generally the copper-sulfate electrolytic solution in the electric plating bath 3 is H+ produced in the sulfuric-acid root ion (SO 4-2) which carried out the remainder to cathode, and an anode plate after passing through electrolytic plating. The electroplating waste fluid of a sulfuric-acid solution is formed. Moreover, in an electroplating process, the copper-sulfate solution concentration in the electric plating bath 3 becomes thin gradually, and serves as copper-sulfate waste fluid which cannot be used at last. And in order to fully use the electroplating waste fluid containing this low concentration copper-sulfate solution and a sulfuric-acid solution, establish an electrolytic-solution inlet port and an electroplating waste fluid outlet in this electric plating bath 3, respectively, and discharge acceptance and electroplating waste fluid for the electrolytic solution according to an individual, and carry out the time style of this electroplating waste fluid to the above-mentioned dissociation tank 2 further, recycle processing is made to perform, and a whole

system is formed in one circulation duct. If the approach and equipment which this invention offers are used, it can prevent that electroplating waste fluid is emitted to arbitration and environmental pollution arises.

[0020] Since flow migration of the copper-sulfate electrolytic solution conveyed by the system of this invention is more smoothly carried out into the electric plating bath 3, the transportation member 5 may be formed in the weak-electric-current solution purification tank 4 above-mentioned lower stream of a river, this transportation member 5 can be formed by the booster pump, pressurization transportation of the electrolytic solution in this weak-electric-current solution purification tank 4 can be carried out, and circulation of a duct can be secured. Moreover, since the electrolytic solution with which it is sent in in the electric plating bath 3 is made to purify more, you may attach the filtration member 6 decoratively in front of the electrolytic-solution inlet port of this electric plating bath 3, and this filtration member 6 is formed by the fine filter media or the activated carbon of a hole, thereby, it can progress further 1 step and **** with which it is contaminated in the electrolytic solution can be removed.

[0021] And in order to enable it to hold the copper-sulfate electrolytic solution built within this dissociation tank 2 beyond a fixed level, In order to prevent that there are too many amounts of the copper compound added by coincidence from this feeding tank 1, and they are wasted, A sensor 7 is circumscribed to the time flow tube way of the electroplating waste fluid of this electric plating bath 3, and the outlet edge of this feeding tank 1 is decorated with the amount-of-supply control-section material 8, and this sensor 7 and this amount-of-supply control-section material 8 are ****(ed), and this sensor 7 is formed with a density measurement analysis machine. Thereby, this sensor 7 controls the rate of the copper-containing mixture spontaneously detected the concentration of the copper sulfate by which contamination mixing is carried out, and sulfuric-acid waste fluid and supplied by this amount-of-supply control-section material 8 from this feeding tank 1 at the electroplating waste fluid in the electric plating bath 3 which carries out a time style, respectively. What is necessary is for there to be especially no limit about this amount-of-supply control-section material 8, and just to be able to carry out the accommodation control of the flow rate. For example, the conventional control-of-flow bulb of general daily use is employable.

[0022] Moreover, as shown in drawing 2 , the anode plate electrode used within the above-mentioned electric plating bath 3 is formed in an undissolved anode plate. What is necessary is just the thing of non-electrical-and-electric-equipment solubility which especially a limit does not have about the quality of the material, and was equipped with only good conductivity. For example, the thing of the quality of the material formed with the oxidization iridium of titanium covering is adopted. Thus, it can prevent that the electrode itself does not dissolve in an electroplating process, therefore plating material is hung on direct heated cathode, hang it, form an anode plate in coincidence at the same appearance configuration as this plating material, make current distribution in the electric plating bath 3 into homogeneity by this, a current carries out local concentration, and the uneven phenomenon of plating produces the anode plate which this invention offers on the front face of plating material.

[0023] Furthermore, in order that circulation of the current in the electric plating bath 3 may carry out as [ smoothly ], this anode plate may be built to porous plate-like one. Moreover, in order to secure the precision of electroplating, it is the most desirable, when the spacing distance of an anode plate and cathode is made to approach as much as possible and is held to 2-3cm range right and left.

[0024]

[Effect of the Invention] since "the electroplating method and the equipment" by the undissolved anode plate of this invention which be constituted as mentioned above can always hold the concentration of the copper sulfate electrolytic solution to a need extent and may change an anode plate configuration freely according to the configuration of a plating material while they can fully recycle the electroplating waste fluid produce within an electric plating bath, they can prevent that the defect phenomenon which a current concentrate locally occur. Furthermore, since the copper compound currently used by this invention does not contain the water molecule, a dilution operation cannot arise to the electrolytic solution in an electric plating bath, but it can reduce energy consumption, and can raise an economic profit. Since in other words the undissolved anode plate where the plating material and appearance configuration of cathode match is adopted and the spacing distance of cathode and an anode plate can be shortened sharply, the precision of electroplating can be secured and it can contribute to a high precision electronic device greatly.

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[Translation done.]

* NOTICES *



1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the equipment layout display Fig. of the comparatively desirable example in this invention.
[Drawing 2] It is the plot plan of the undissolved anode plate and plating material in this invention.
[Drawing 3] It is the plot plan of the conventional soluble anode plate and plating material.
[Description of Notations]
1 Feeding Tank
2 Dissociation Tank
3 Electric Plating Bath
4 Weak-Electric-Current Solution Purification Tank
5 Transportation Member
6 Filtration Member
7 Sensor
8 Amount-of-Supply Control-Section Material
21 Dashboard
22 Storing Space

[Translation done.]